

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

**As rescanning documents *will not* correct images,
please do not report the images to the
Image Problem Mailbox.**

AMENDMENTS TO THE SPECIFICATION

Please replace paragraph [0002] with the following amended paragraph:

[0002] In recent years there has been an increased concern in the United States and elsewhere about air pollution from industrial emissions of noxious oxides of nitrogen, sulfur and carbon. In response to such concerns, government agencies have ~~in some cases already~~ placed limits on allowable emissions of one or more of these pollutants, and the trend is clearly in the direction of increasingly stringent regulations.

Please replace paragraph [0008] with the following amended paragraph:

[0008] Additives have also been used in attempts to deal with NO_x emissions. U.S. Patent Nos. 6,379,536, 6,280,607, 6,129,834 and 6,143,167 disclose the use of NO_x removal compositions for reducing NO_x emissions from the FCCU regenerator. U.S. Patent No. 6,165,933 and 6,358,881 also discloses a NO_x reduction composition, which promotes CO combustion during the FCC catalyst regeneration process step while simultaneously reducing the level of NO_x emitted during the regeneration step. NO_x reduction compositions disclosed by these patents may be used as an additive, which is circulated along with the FCC catalyst inventory or incorporated as an integral part of the FCC catalyst.

Please replace paragraph [0010] with the following amended paragraph:

[0010] Many additive compositions heretofore used to control NO_x emissions have typically caused a significant decrease in hydrocarbon conversion or the yield of valuable cracked products, e.g., gasoline, light olefins and liquefied petroleum gases (LPGs), while increasing the production of coke. It is a highly desirable characteristic for NO_x additives added to the FCCU not to affect the cracked product yields or change the overall unit conversion. The operation of the

FCCU is typically optimized based on the unit design, feed and catalyst to produce a slate of cracked products, ~~which~~ and maximizes refinery profitability. This product slate is based on the value model of the specific refinery. For example, during the peak summer driving season many refiners want to maximize gasoline production, while during the winter season refiners may want to maximize heating oil production. In other cases a refinery may find it profitable to produce light olefins products that can be sold in the open market or used in an associated petrochemical plant as feedstocks.

Please replace paragraph [0021] with the following amended paragraph:

[0021] The FIGURE is a graphic representation of the effectiveness of Additive A, Additive B, Additive C, Additive D and Additive E prepared in EXAMPLES 1, 2, 3, 4 and 5 respectively, to reduce NO_x emissions from a DCR regenerator versus time on stream, when the additives are blended ~~in a FCCU~~ with an equilibrium cracking catalyst (having the properties as shown in Table 3 2), which contained 0.25 weight percent of a platinum promoter, CP-3[®] (obtained from Grace Davison, Columbia, MD) and ~~which was deactivated using the Cyclic Propylene Steaming procedure as described in EXAMPLE 6~~.

Please replace paragraph [0024] with the following amended paragraph:

[0024] For purposes of the present invention, the phrase “a substantial ~~reduction or~~ change in hydrocarbon feed conversion or the yield of cracked products” is defined herein to mean in the alternative (i) less than a 30% relative change, preferably less than a 20% relative change and most preferably less than a 10% relative change in the yield of LCO (light cycle oils), bottoms and gasoline in combination with ~~LGP~~ LPG as compared to the baseline yield of the same products; or (ii) less than a 10% relative change, preferably less than a 6.5% relative change and most preferably less than a 5% relative change in the hydrocarbon feed conversion as compared to the baseline conversion. The

conversion is defined as 100% times (1 – bottoms yield – LCO yield). When the NO_x reduction composition is used as a separate additive, the baseline is the mean conversion or yield of a product in the FCCU, operating with the same feed and under the same reaction and unit conditions, but before the additive of the present invention is added to the catalyst inventory. When the NO_x reduction composition is integrated or incorporated into the cracking catalyst particles to provide an integral NO_x reduction catalyst system, a significant ~~reduction or~~ change in the hydrocarbon conversion or yield of cracked products is determined using a baseline defined as the mean conversion or yield of a product in the same FCCU operating with the same feed, under the same reaction and unit conditions, and with a cracking catalyst inventory comprising the same cracking catalyst composition as that containing the NO_x reduction composition, except that the NO_x reduction composition is replaced in the cracking catalyst with a matrix component such as kaolin or other filler. The percent changes specified above are derived from statistical analysis of DCR operating data.

Please replace paragraph [0027] with the following amended paragraph:

[0027] The amount of NO_x reduction zeolite used in the catalyst/additive compositions of the invention will vary depending upon several factors, including but not limited to, the mode of combining the NO_x reduction zeolite with the catalytic cracking catalyst and the type of cracking catalyst used. In one embodiment of the invention, the compositions of the invention are separate catalyst/additive compositions and comprise a particulate composition formed by binding particles of a NO_x reduction zeolite component with a suitable inorganic binder. Generally, the amount of the NO_x reduction zeolite component present in the particulate compositions of the invention is at least 10, preferably at least 30, most preferably at least 40 and even more preferably at least 50, weight percent based on the total weight of the composition. Typically, the particulate catalyst/additive composition of the invention contains from about 10 to about 85, preferably from about 30 to about 80, most preferably, from about 40 to about 75,

weight percent of the NO_x reduction zeolite component based on the total weight of the catalyst/additive composition.

Please replace paragraph [0028] with the following amended paragraph:

[0028] Binder materials useful to prepare the particulate compositions of the invention include any inorganic binder which is capable of binding a zeolite powder to form particles having properties suitable for use in the FCCU under FCC process conditions. Typical inorganic binder materials useful to prepare compositions in accordance with the present invention include, but are not limited to, alumina, silica, silica-alumina, aluminum phosphate and the like, and mixtures thereof. Preferably, the binder is selected from the group consisting of alumina, silica, silica-alumina. More preferably, the binder comprises alumina. Even more preferably, the binder comprises an acid or base peptized alumina. Most preferably, the binder comprises an alumina sol, e.g., aluminum chlorohydrate. Generally, the amount of binder material present in the particular catalyst/additive compositions comprises from about 5 to about 50 weight percent, preferably from about 10 to about 30 weight percent, most preferably from about 15 to about 25 weight percent, of the catalyst/additive composition of the invention.

Please replace paragraph [0030] with the following amended paragraph:

[0030] Particulate catalyst/additive compositions of the invention should have a particle size sufficient to permit the composition to be circulated throughout the FCCU simultaneously with the inventory of cracking catalyst during the FCCU FCC process. Typically the composition of the invention will have a mean particle size of greater than 45 µm. Preferably, the mean particle size is from about 50 to about 200 µm, most preferably from about 55 to about 150 µm, even more preferred from about 60 to about 120 µm. The compositions of the invention typically have a Davison attrition index (DI) value of less than about 50, preferably less than about 20, most preferably less than about 15.

Please replace paragraph [0042] with the following amended paragraph:

[0042] Typical FCC processes are conducted at reaction temperatures of 480°C to 600°C with catalyst regeneration temperatures of 600°C to 800°C. As it is well known in the art, the catalyst regeneration zone may consist of a single or multiple reactor vessels. The compositions of the invention may be used in FCC processing of any typical hydrocarbon feedstock. Suitable feedstocks include petroleum distillates or residuals of crude oils having a boiling point range of about 150°C to about 900°C, preferably, about 200°C to about 800°C, which when catalytically cracked, provide either a gasoline or a ~~gas oil~~ other petroleum product. Synthetic feeds having boiling points of about 200°C to about 800°C, such as oil from coal, tar sands or shale oil, can also be included.

Please replace paragraph [0049] with the following amended paragraph:

[0049] Another class of non-zeolitic NO_x reduction materials suitable for use in combination with the NO_x reduction compositions of the invention include magnesium-aluminum spinels based additives heretofore being useful for the removal of sulfur oxides from a FCC regenerator. Exemplary patents which disclose and describe this type of materials include U.S. Patent Nos. 4,963,520, 4,957,892, 4,957,718, 4,790,982, 4,471,070, 4,472,532, 4,476,245, 4,728,635, 4,830,840, 4,904,627, 4,428,827, 5,371,055, 4,495,304, 4,642,178, 4,469,589, 4,758,418, 4,522,937, 4,472,267 and 4,495,305 the entire disclosure of said patents being herein incorporated by reference. Preferably, compositions in this class comprise at least one metal-containing spinel which includes a first metal and a second metal having a valence higher than the valence of said first metal, at least one component of a third metal other than said first and second metals and at least one component of a fourth metal other than said first, second and third metals, wherein said third metal is selected from the group consisting of Group IB metals, Group IIB metals, Group VIA metals, the rare-earth metals, the Platinum Group metals and mixtures thereof, and said fourth metal is selected from the

group consisting of iron, nickel, titanium, chromium, manganese, cobalt, germanium, tin, bismuth, molybdenum, antimony, vanadium and mixtures thereof. Preferably, the metal containing spinel comprises magnesium as said first metal and aluminum as said second metal, and the atomic ratio of magnesium to aluminum in said spinel is at least about 0.17. The third metal in the spinel preferably comprises a metal selected from the group consisting of the Platinum Group metals, the rare-earth metals and mixtures thereof. The third metal component is preferably present in an amount in the range of about 0.001 to about 20 weight percent, calculated as elemental third metal, and said fourth metal component is present in an amount in the range of about 0.001 to about 10 weight percent, calculated as elemental fourth metal.